THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:-

1. A method for supporting a plurality of virtual channel connections within a single virtual path in a digital communications network operating in the Asynchronous Transfer Mode (ATM), where said virtual channel connections have no guarantees of rate at which cells on that connection can be transmitted, but also have no restriction on said rate save that inherent on said virtual path connection, said method comprising the steps of:

storing cells arriving for transmission on said virtual path in a buffer for transmission of cells on said virtual path in conformance with said constraint on said rate;

detecting whether buffer overflow is threatened by the storage of further cells arriving for transmission on said virtual path; and,

while buffer overflow is threatened, admitting for storage in said buffer cells only on such of said virtual channel connections on which the previous cell admitted was not indicated by the header of said previous cell as being the end of transmission on said virtual channel; and,

at all times not admit for storage in said buffer any cells on said virtual channel connections for which since the previous indication of said end of transmission on said virtual channel connection there has been any rejection of cells for storage.

2. A method for supporting a plurality of virtual paths on a single physical cell transmission system in a digital communications network operating in the Asynchronous Transfer Mode (ATM), each virtual path supporting a plurality of virtual channel connections, where each said virtual path has an individual rate constraint, the method comprising steps of:

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storing cells arriving for transmission on any one of said virtual paths in a common buffer for transmission on said physical cell transmission system;

scheduling the stored cells for transmission on said physical cell transmission system at time instants that conform with said individual rate constraints on said virtual paths, and preserving the order of transmission cells on a said virtual path to the order of arrival for said path;

detecting whether buffer overflow is threatened by the storage of further cells for transmission on any of said virtual paths, and detecting whether said scheduling on a particular virtual path is over a specified limit; and for any cell arriving for transmission on a given virtual path,

while buffer overflow is threatened or the scheduling for said virtual path is over the specified limit, admitting for storage in said buffer and scheduling for transmission cells only on such of said virtual channel connections on which the previous cell admitted was not indicated by the header of said previous cell as being the end of transmission on said virtual channel; and,

at all times not admit for storage in said buffer any cells on said virtual channel connections for which since the previous indication of said end of transmission on said virtual channel connection there has been any rejection of cells for storage.

3. A method according to ~~claims 1 or 2~~ claim 1, wherein the detection of threatened buffer overload is made on the assessment of the number of unoccupied locations in said buffer at the time of arrival of a cell for said transmission.

4. A method according to claim 3, wherein buffer overload is deemed to be threatened when the number of unoccupied locations in said buffer at the time of arrival

of a cell for said transmission is less than the threshold level.

5. A method according to claim 3, wherein said threshold level dynamically varies dependent on the rate of cells incoming for said transmission and the rate of reading cells out of said buffer onto the transmission system.

6. A method according to claim 2, wherein the detection of scheduling on a virtual path being over the limit is made on the assessment of the delay on said virtual path.

7. A method according to claim 6, wherein scheduling on a virtual path is deemed as over the limit if at the time of arrival of a cell the last scheduled cell on said virtual path is still more than a threshold value into the future.

8. A method according to claim 1, further comprising the step of forming an admit list (AL) and a reject list (RL) on the basis of cells arriving for transmission for determining on which virtual channel connections cells are to be admitted or rejected for storage in said buffer, said lists being formed by reading the identifier information and end of transmission information in the header of a cell, and said AL and RL carrying entries of said identifier information however applicable, and in the event of a cell arriving for transmission and not marked as end of transmission, then if said identifier information of said cell matches that on said RL, the cell is rejected; if it does not match any on said RL and if it does match on said AL, the cell is admitted; if it matches neither said RL nor said AL and if buffer overflow is threatened or the scheduling for said virtual path is over the limit, the cell is rejected and

entered on said RL, and otherwise the cell is admitted and entered on said AL; and in the event a cell arrives with end of transmission indicated, then if said identifier matches said RL then the cell is rejected and its identifier is cleared from said RL, and if its identifier does not match said RL and matches said AL, the cell is admitted and its identifier cleared from the said AL; and if the identifier does not match either said RL or said AL, the cell is admitted or rejected depending on the state of buffer and scheduling of the virtual path without being entered in either said RL or said AL.

9. A method according to claim 8, wherein said identifier information consists of a Virtual Path Identifier and Virtual Channel Identifier and said end of transmission information is a unique code point of the Payload Type Identifier.

10. A method according to ~~any one of the preceding claims~~ claim 1, wherein said constraint on said virtual path connection is in terms of a specified shortest allowed time interval between successive cells on said virtual path.

11. An apparatus for supporting a plurality of virtual channel connections within a single virtual path in a digital communications network operating in the Asynchronous Transfer Mode (ATM), where said virtual channel connections have no guarantees of rate of which cells on that connection can be transmitted, but also have no restriction on said rate save that inherent on said virtual path connection, where said constraint on said virtual path connection is in terms of a specified shortest allowed time interval between successive cells on said virtual path, said apparatus comprising:

means for storing cells arriving for transmission on said virtual path in a buffer for transmission of cells

on said virtual path in conformance with said constraint on said rate;

means for detecting whether buffer overflow is threatened by the storage of further cells arriving for transmission on said virtual path; and,

means for admitting for storage in said buffer while buffer overflow is threatened cells only on such of said virtual channel connections on which the previous cell admitted was not indicated by the header of said previous cell as being the end of transmission on said virtual channel, and wherein said admitting means at all times does not admit for storage in said buffer any cells on said virtual channel connections for which since the previous indication of said end of transmission on said virtual channel connection there has been any rejection of cells for storage.

12. An apparatus for supporting a plurality of virtual paths on a single physical cell transmission system in a digital communications network operating in the Asynchronous Transfer Mode (ATM), each virtual path supporting a plurality of virtual channel connections, where each virtual path has an individual rate constraint said apparatus comprising:

means for storing cells arriving for transmission on any one of said virtual paths in a common buffer for transmission on said physical cell transmission system;

means for scheduling the stored cells for transmission on said physical cell transmission system at time instants that conform with said individual rate constraints on said virtual paths, and preserving the order of transmission of cells on a said virtual path to the order of arrival for said path;

means for detecting whether buffer overflow is threatened by the storage of further cells for transmission on any of said virtual paths, and detecting whether said scheduling on a particular virtual path is over a specified

limit; and for any cell arriving for transmission on a given virtual path; and,

means for admitting for storage in said buffer and scheduling for transmission while buffer overflow is threatened or the scheduling for said virtual path is over the specified limit, cells only on such of said virtual channel connections on which the previous cell admitted was not indicated by the header of said previous cell as being said end of transmission on said virtual channel, and wherein said admitting means at all times does not admit for storage in said buffer any cells on said virtual channel connections for which since the previous indication of said end of transmission on said virtual channel connection there has been any rejection of cells for storage.

13. An apparatus according to claim 11 ~~or 12~~, wherein the detection of threatened buffer overload is made on the assessment of the number of unoccupied locations in said buffer at the time of arrival of a cell for said transmission.

14. An apparatus according to claim 13, wherein buffer overload is deemed to be threatened when the number of unoccupied locations in said buffer at the time of arrival of a cell for said transmission is less than the threshold level.

15. An apparatus according to claim 14, wherein said threshold level dynamically varied dependent on the rate of cells incoming for said transmission and the rate of reading cells out of said buffer onto the transmission system.

16. An apparatus according to claim 12, wherein the detection of scheduling on a virtual path being over the

limit is made on the assessment of the delay on said virtual path.

17. An apparatus according to claim 14, wherein scheduling by said scheduling means on a virtual path is deemed as over the limit if at the time of arrival of a cell the last scheduled cell on said virtual path is still more than a threshold value into the future.

18. An apparatus according to ~~any one of claims 11 to 17~~ claim 11, further comprising means for forming an admit list (AL) and a reject list (RL) on the basis of cells arriving for transmission for determining on which virtual channel connections cells are to be admitted or rejected for storage in said buffer, said lists being formed by reading the identifier information and end of transmission information in a cell, and said AL and RL carrying entries of said identifier information, and in the event of a cell arriving for transmission and not marked as end of transmission, then if said identifier information of said cell matches that on said RL, the cell is rejected; if it does not match any on said RL and if it does match on said AL, the cell is admitted; if it matches neither said RL nor said AL and if buffer overflow is threatened or the scheduling for said virtual path is over the limit, said cell is rejected and entered on said RL, and otherwise said cell is admitted and entered on said AL; and in the event a cell arrived with end of transmission indicated, then if said identifier matches said RL then said cell is rejected and its identifier is cleared from said RL, and if its identifier does not match said RL and matches said AL, said cell is admitted and its identifier cleared from said AL; and if the identifier does not match either said RL or said AL, the cell is admitted or rejected depending on the state of buffer and scheduling of the virtual path without being entered in either said RL or said AL.

19. An apparatus according to claim 18, wherein said identifier information consisting of the Virtual Path Identifier and Virtual Channel Identifier and said end of transmission information being a unique code point of the Payload Type Identifier.

20. A method of scheduling the reading out of a data cell from a buffer onto an output comprising the steps of:

calculating a service time S for the reading out of said data cell from said buffer, said service time comprising a delay period measured from the actual time of arrival t_a of a cell to said buffer, said delay equal to at least the difference between an expected arrival time of that cell and the actual arrival time t_a when said cell arrives earlier than expected, and said delay equal to zero when said cell arrives on time or later than expected; and,

reading out said cell at said service time S or at the next time available on said output in the event that said output is not available for reading said cell at said service time S.

21. A method according to claim 20, further comprising the step of forming a linked list containing the buffer address of each cell scheduled for service at time S and wherein each cell scheduled for service at time S is appended to said linked list with said cells ranked on said linked list in order of arrival with the address of the earliest arriving cell at the head of said linked list.

22. A method according to claim 20 ~~or 21~~, wherein said service time S is calculated in units of cell service intervals where a cell service interval is the reciprocal of the cell transmission rate on said output, and S=N+ND where N is the time at the beginning of the current cell service interval and ND is the Ceiling (said delay period/ said cell transmission rate).

23. A method according to claim 22, further comprising the step of fetching the linked list for S=N for determining whether any cells are to be read onto said output at the current cell service interval.

24. A method according to claim 23, wherein in the event that more than one cell is to be read out of said buffer onto said output at the current cell service interval N all remaining tasks on said linked list scheduled for service at N are rescheduled for the next cell service interval and serviced ahead of those tasks previously scheduled for service at S=N+1.

25. An apparatus for scheduling the reading out of data cells from a buffer onto a data output comprising:

means for calculating a service time by reading out said data cells from said buffer, said service time comprising a delay period measured from the actual time of arrival t_a of a cell to said buffer, said delay equal to at least the difference between the expected arrival time of that cell and the actual arrival time t_a when said cell arrives on earlier than expected, and said delay equal to zero when said cell arrives on time or later than expected; and,

means for reading out said cell at said service time S or at the next time available on said output in the event that said output is not available for reading said cell at said service time S.

26. An apparatus according to claim 25, further comprising means for forming a linked list containing the buffer address of each cell scheduled for service at time S and wherein each cell scheduled for service at time S is appended to said linked list with said cells ranked on said linked list in the order of arrival on with the address of the earliest arriving cell at the head of said linked list.

27. An apparatus according to claim 26 further comprising means for calculating said service time S in units of cell service intervals, where a cell service interval is the reciprocal of the cell transmission rate on said output, and S = N + ND where N is the time at the beginning of the current cell service interval and ND is the Ceiling (said delay period/said cell transmission rate).

28. An apparatus according to claim 27, further comprising means for fetching said linked list for S = N for determining whether any cells are to be read onto said output at the current cell service interval.

29. An apparatus according to claim 28, wherein in the even that more than one cell is to be read out of said buffer onto said output at the current cell surface interval N, said upon reading out of said first cell, all remaining tasks on said linked list scheduled for service at N are rescheduled for the next cell service interval and serviced ahead of those tasks previously scheduled for service at S = N + 1.

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